ation. In comparing them with *Limax* and *Arion*, he did not find the mantle shield much shorter than the body, and plainly evident, like the one of those slugs, and came to the conclusion that there was none at all; conceded that it was one of the careless things he was in the habit of doing. Also, if *Philomycus* was not the same thing as *Tebennophorus*, etc., the family name Philomycidæ, in the sense as used, has no claim for recognition.

THE SHELL OF PHILOMYCUS CAROLINIANUS (BOSC).

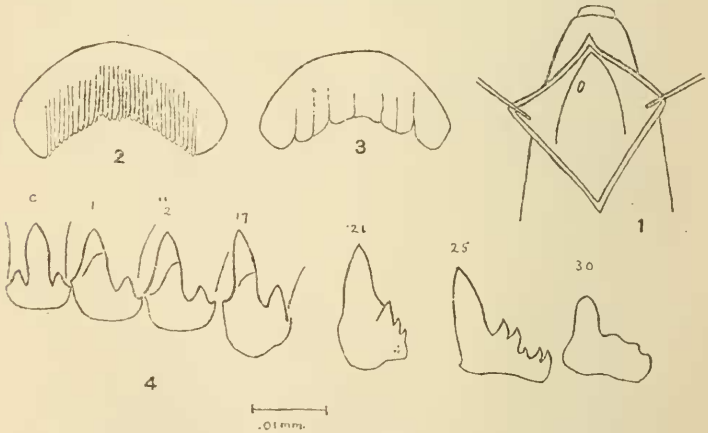
BY WILLIAM F. CLAPP.

Through the kindness of Mr. J. Henry Blake I recently received a specimen of *Philomycus carolinianus* (Bosc.), from Munsonville, N. H., to examine for internal parasites. On laying open the mantle preparatory to removing the stomach and intestine, I discovered a rudimentary shell. When first noticed, it was not attached, either to the mantle or to the inner membrane which covers the viscera, but was floating free in the liquid in which the dissection was made. From its position I believed it to have been dislodged from some portion of the posterior fourth of the animal, between the mantle and the inner membrane. Losing immediately all interest in possible internal parasites, I gave my attention entirely to the problem of the shell, in an endeavour to ascertain its exact position, and also to discover whether it is to be considered a constant, or merely an occasional character in this species.

From Dr. R. C. Rush, of Hudson, Ohio, I received fifty specimens (M. C. Z. 48211) of living *Philomycus* in excellent condition. The specimens in this lot show slight variation in color, the majority being of the typical pattern, of a yellowish-white ground color, variegated with brownish and blackish clouds and spots, forming three ill-defined longitudinal bands, one on the center of the back, and one on each flank. There are, however, three specimens easily separated from the rest because of the reddish tinge in the brownish clouds and spots. In these specimens (M. C. Z. 48211 H) the lateral bands are

lacking entirely, there being one broad dorsal band of darker reddish brown, bounded on each side by a narrow row of more or less connected black spots.

In the eighteen specimens of this lot examined, all possessed a rudimentary shell. In many cases, in spite of the greatest care in making the incision in the mantle, the shell had become dislodged from its normal position. In eight specimens it remained attached to the animal when found. In all of these specimens it was adherent to the outer surface of the inner membrane or peritoneum, and not connected in any way to the inner surface of the mantle. It also, in the specimens in which it remained fastened, was always in the posterior quarter of the animal, and over some portion of the liver. In two of the eight specimens it occurred on the left side, in two directly on top, and in four on the right side of the liver. The diagram (fig. 1) was made from a specimen (M. C. Z. 48211 H) measuring 40 mm. in length in a considerably contracted condition. On opening the mantle, the position of the shell was found to be 5 mm. from the posterior extremity of the animal and on



Figs. 1, 2, 3, *Philomycus carolinianus* (Bosc), Hudson, Ohio.
Fig. 4, *P. rushi*, n. sp.

the right side. It is of a light horn color, transparent, very iridescent, thin, delicate, wrinkled. It measures .5 mm. in length and .25 mm. in width. In appearance it greatly re-

sembles the periostracum of the shell of a *Limax maximus* which remains when the shell has been decalcified in weak acid.

In some of the shells extracted from specimens from Hudson, Ohio, a portion of the delicate membrane contains a few granules of what appear to be calcareous crystals. In outline the rudimentary shell is irregular, the membrane becoming very thin, delicate and transparent at the edge. In some specimens it was folded on itself, but the general tendency is for it to be oblong rather than oval, and in outline, not unlike the shell of *Limax maximus*. Specimens from the following localities were examined, in all but one of which the rudimentary shell was found.

Spec's.	*M. C. Z. No.*	*Locality.*	*Received from.*
1	18540	Isle au Haute, Me.	M. C. Z.
1	48207	Munsonville, N. H.	J. Henry Blake.
1	48217	Mt. Monadnock, N. H.	Dr. W. H. Dall.
2	42145	Duxbury, Mass.	M. C. Z. (shell not found in one).
1	48212	Tannersville, N. Y.	Dr. H. A. Pilsbry.
18	48211	Hudson, Ohio.	Dr. R. C. Rush.
2	48214	York Furnace, Pa.	Dr. H. A. Pilsbry.
2	48213	York Co., Pa.	Dr. H. A. Pilsbry.
4	48215	Wyoming Co., Pa.	Dr. H. A. Pilsbry.

This species was originally described as *Limax carolinianus* (Bosc, Hist. Nat. des Vers, suites à Buffon, ed Deterville, 1, p. 80, pl. 3, f. 1, 1802. Rafinesque (Annals of Nature, p. 10, 1820) gave the name of *Philomycus* to species which differed from *Limax*, principally, in being entirely destitute of a mantle. Rafinesque, however, made no mention of *Limax carolinianus* in this paper and it remained for Ferussac (Tab. Syst., p. 15, 1821) to place the species, which he spells *caroliniensis*, in Rafinesque's genus *Philomycus*. Binney (Bost. Journ. Nat. Hist., 4, p. 163, 1842), recognizing the fact that *carolinianus* Bosc. possessed a mantle covering the entire upper surface of the animal, removed the species from Rafinesque's genus *Philomycus*, where Ferussac had placed it, and made it the type of a new genus,

Tebennophorus, signifying "wearing a cloak". In diagnosing the genus, Binney states that it is "without testaceous rudiment". Wyman (Bost. Journ. Nat. Hist., 4, p. 411, 1844) and Leidy (Terr. Moll. U. S., 1, p. 250, pl. 3, 1851) in describing the anatomy of *Tebennophorus*, did not mention finding a rudimentary shell. W. G. Binney (Terr. Moll. U. S., 5, p. 179, 1878) specifies that *Tebennophorus* has no external or internal shell, and adds (p. 180) that "the internal, rudimentary, nail like shell, described by Dr. Gray, has not been noticed by any American author". Dr. Gray's description (Cat. Pulmon. Brit. Mus., part 1, p. 158, 1855) of the genus *Philomycus*, includes the statement, "Shell minute, nail like, concealed in the front part of the mantle". Yet (p. 155) in describing the tribe *Philomycina*, in which he places the genus *Philomycus*, he states, "Shell none". From Dr. Gray's description of the shell as being "nail-like", and "concealed in the front part of the mantle", I doubt that he had the shell of *Philomycus carolinianus*.

An examination of the jaw and radula of each of the specimens in which a shell was found, disclosed the fact that the jaw varies considerably in specimens apparently otherwise identical. In the fifteen specimens from Hudson, Ohio (M. C. Z. 48211), which I consider typical *carolinianus* (Bosc), as described by Binney, thirteen possessed a smooth jaw, with very faint longitudinal and transverse striae showing only when highly magnified. The remaining two were strongly plaited (figs. 2, 3). Of the three specimens (M. C. Z. 48211 H) separated from the others because of the reddish tinge of the mantle, the jaw of one was similar to fig. 2, the others were smooth. This plaiting of the jaw, although it may be felt with a fine needle, is not to be confused with the ribbing of the jaw as seen in *Pallifera dorsalis* Binney (Morse, Journ. Port. Soc. Nat. Hist., 1, p. 8, f. 5, 1864). That portion of the mouth which carries the jaw in *Philomycus carolinianus*, is always deeply furrowed, and it appears that these furrows may, or may not leave their impression upon the jaw. It is possible that the presence or absence of plaiting in the jaw may be entirely a question of age. In all of the specimens examined none of the other char-

acters showed noteworthy variation, and I have considered them all *P. carolinianus.*

It is worthy of record that the specimens which were sent to me in such excellent condition by Dr. R. C. Rush, were shipped in a small wooden box filled with damp, absolutely clean moss. Every specimen was alive. The slightest amount of dirt or dust in the material in which the specimens are packed is fatal. From one of Dr. Rush's letters I take the liberty of quoting some interesting notes regarding the habits of the species.

"It is very easy to collect specimens of this species, but very difficult to send them any considerable distance and have them live. If kept too moist they suffocate, and if allowed too much air they dry up. I have had five-inch specimens die in twenty minutes in strong sunlight. To keep specimens alive, place them on the under side of an old piece of bark on the basement floor, making certain that they are absolutely in the dark. Feed them with any fungi and they will live for months. Curiously the large specimens of this species are not found in damp places in northern Ohio. They are found here in high, dry, hard-maple and beech forests, on stumps and logs which have not decayed much, in pockets under the bark. They feed at night and go back to the same nest every morning. Very rarely one will find them feeding on the under side of fungi in daylight. It will interest you to know that nine of the specimens I am sending came from a crack in a log, seven inches long by two inches wide, and I left seven behind. They were packed in like sardines."

Philomycus rushi, sp. nov.

In alcohol, mantle smooth, drab gray above (Ridgway, Color Standards and Nomenclature, pl. 46, 1912), lighter on the sides, eye peduncles dark gray, eye spots black, tentacles, situated beneath and very slightly outside the eye peduncles, short, gray. Body terminating posteriorly in a sharp point. Foot narrow, half the width of the body, cream-white below, excepting at the anterior end, where it is dark red, fading at the posterior end. The separation of the foot from the body well defined. The body, showing at the sides between the foot

and the mantle, only as a narrow ridge at the posterior end, but broadening at the anterior, is also stained with red, darker at the anterior end. Respiratory orifice, small, on the right side, 2.5 mm. behind the anterior edge of the mantle, in the center of the narrow mantle furrow which curves upward and backward from the mantle edge. Total length 15 mm., width 3 mm.

Internal rudimentary shell large, similar to that of *P. carolinianus* (Bosc), 6 mm. from the posterior extremity, and fastened to that portion of the peritoneum directly above the ovotestis. Approximately 2 mm. in diameter.

The jaw is similar to that of *P. carolinianus* in shape, and in being but very slightly plicate.

The radula, fig. 4, consists of about 150 rows of teeth having a formula of 38-1-38.

The one specimen received in sufficiently good condition to examine the internal organs, was infested with two stages of parasitic Trematoda. Twenty of these were found in the vicinity of the lung, one beneath the shell, and one in the penis near the retractor muscle. Therefore the reproductive organs in this specimen may be in an abnormal condition, and on this account I refrain from figuring them. One of the most noticeable differences is the complete absence of any glandular portion to the cloaca, a large and constant character in *P. carolinianus*. The ovotestis is nearly black, in sharp contrast to the light-colored liver and other organs in the posterior portion of the animal.

Type M. C. Z. 48220. Hudson, Ohio, collected by Dr. R. C. Rush.

I have connected Dr. Rush's name with this species as a slight recognition of the care and perseverance he has exercised for many years in studying the life history of the land shells of Ohio.

Dr. Sterki (Proc. Ohio State Acad. Sci., 4, p. 377) describes a closely related species as "*Philomycus* sp. *pennsylvanicus* Pils.?" Dr. Sterki's species is similar to *P. rushi* in that it possesses a "sole tinged with blood red" but differs in being twice as large (30 mm. long), and in the jaw having "a num-

ber of rib-like irregular ridges''. *P. pennsylvanicus* Pils. (Proc. Acad. Nat. Sci. Phil., p. 22, 1894) is described as being ''smaller and less distinctly marked than *P. carolinensis*'' and ''having the jaw strongly ribbed'', a description which could not be applied to *P. rushi*.

CLIMATIC CONDITIONS AS INDICATED BY LAND SHELLS ON THE ISLAND OF OAHU.

BY J. J. GOUVEIA.[1]

Since the early part of 1913 the writer and his brother A. Gouveia have been engaged in making a collection of Hawaiian land shells, both ground and tree. We have accumulated specimens of shells from nearly all valleys and ridges on the island of Oahu. We have complete data as to the exact locality and habits, so it can be seen that the writer has a good proof, from his series, of Gulick's theories of segregation or isolation. This idea has been written and followed out by many other collectors and students until it is well known in the scientific world. One of the best examples of this is seen in Dr. Cooke's paper on *Achatinella multizona*.

Distribution of *Achatinella cestus* from Manoa-Palolo Ridge to Wailupe-Niu Ridge.—*Achatinella cestus* (Newcomb) is found mostly on lehua or one of its related plants having a rather large dark green and glossy leaf, on Ieie, Opiko and Lantana, and nearly always under leaves, with the exception of the Wailupe-Niu locality where they are found mostly on Lantana stems. They are nearly always found sealed. The only time they are found extended is when they are disturbed by wind or rain or accidentally brushed off, so they must be nocturnal as Dr. Cooke surmises (1).

They are very variable in color from white to very dark brown. They are lighter on the western part of the range and become darker towards the eastern part. The greater part of these shells have a white border band (2).

[1] Contribution from the Gulick Natural History Club.